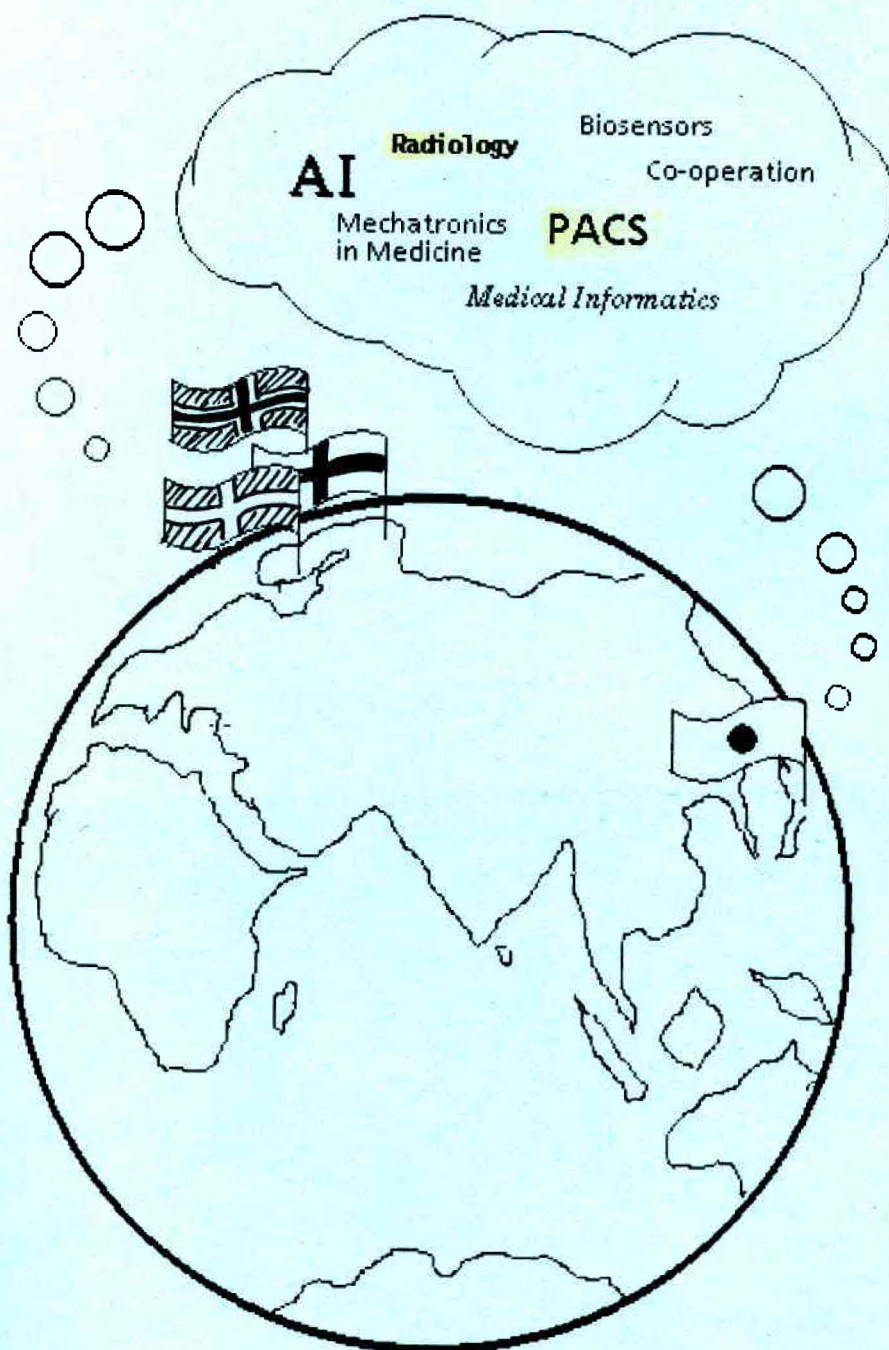


1987

Travel report of the Nordic delegation  
to Japan  
with the theme

**COLLABORATION BETWEEN JAPAN AND THE  
NORDIC COUNTRIES IN MEDICAL TECHNOLOGY**

March 6-15, 1987



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Tampere 27.10.1987

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Ref

**NORDIC DELEGATION TO JAPAN  
COLLABORATION BETWEEN JAPAN AND THE  
NORDIC COUNTRIES IN MEDICAL TECHNOLOGY  
March 6-15, 1987**

Dear Sir,

Enclosed please find a copy of our travel report.

May I once more take this opportunity and thank you for being able to visit your institution and for your hospitality during our visit.

Yours sincerely,

Director of Laboratory,  
Professor  
Leader of the Nordic delegation

  
Niilo Saranummi

## PREFACE

A delegation of 16 engineers, physicists and physicians representing a wide base of expertise in medical engineering, medical physics and medical informatics from Finland, Norway and Sweden visited Japan March 6-15, 1987. The participants of the delegation came from the hospitals (6 persons), research institutes (2 persons) and universities (6 persons). In addition some of the participants were government officials (4 persons) responsible of medical technologies and the funding of R&D in this area. Appendix 1 presents the names and affiliations of the participants.

The main reasons for this visit were the high standard of medical care Japan and the reputation of Japan as a high-technology country investing large sums in R & D. A contributing factor for the visit was that an expert in medical technology, dr. Erkki Vauramo acted as a temporary Scientific and Technical Attachee at the Finnish Embassy in Japan for three months (January to March, 1987). His task was to study the health care system in Japan, how R&D in medical technology is carried out and how these interact and are intercoupled.

For these reasons it was considered appropriate to organize this visit with the following objectives

- to get acquainted with the Japanese health care system,
- to meet and form contacts with Japanese specialists in the research of medical technologies, and
- to explore the possibilities of cooperation between researchers.

The programme of the visit (Appendix 2) consisted of 30 visits to places of interest. For these visits the delegation was divided into small interest groups. The composition of the groups varied from case to case (as listed in the programme of Appendix 2). Division into smaller groups made it possible to cover more subjects

during the one week visit and enabled more in-depth discussions.

On Tuesday evening the Finnish Ambassador in Japan, Mr. Opas gave a reception for the delegation. The names of the Japanese guests are given in Appendix 3. On Saturday a closing workshop was arranged at Sweden House, which concluded with a lunch hosted by the Swedish Embassy. For the other evenings the Japanese side arranged receptions (Toshiba on Monday and the Japanese Association for Electrotechnical Industries, JAEI on Wednesday). All these occasions were very enjoyable and valuable since they provided a forum for informal exchange of opinions.

The programme was arranged by the Scientific and Technical Attachees at the Finnish and Swedish Embassies in Tokyo (mr. Seppo Raevuori, dr. Erkki Vauramo and dr. Hans Nilsson respectively) jointly with dr. Koji Okamoto, Ministry of Health and Welfare (MHW), prof. Masao Saito and dr. Kenji Ikeda, Tokyo University. The practical arrangements were handled by mrs. Hiroko Diehl, Finnish Embassy. The delegation wants to thank very warmly these persons for all their efforts and help in organizing the programme and carrying it through.

The visit was funded from many sources. The main financiers were the Ministry of Trade and Industry in Finland and the Technological Development Board (STU) in Sweden.

This travel report has been written by all the participants. Each was given the reporting task for a particular visit (as indicated after each chapter).

Tampere, May 29, 1987

Niilo Saranummi  
Yrjö Jokinen  
Toivo Katila

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## 1 INTRODUCTION

### 1.1 Health care and medical technology in Japan

#### General

Japan is a country of 20 000 islands. Its surface area is a little greater than that of Finland but only 15 % of it is agricultural area. The number of inhabitants is over 120 million. The population density is 319 persons/km<sup>2</sup>.

The age structure is presently changing. The average life expectancy is for men 74,5 years and for women 80,5 years. These are the highest figures in the world. The percentage of elderly persons (over 65 years) of the population is presently 10%, whereas in Finland and Sweden the respective figures are 13% and 15%.

#### Hospitals

The Japanese health care system is financed through insurance payments. Every citizen is insured. In some cases the premiums are paid by the employer. The employers may also insure the whole family. In such cases the insured must himself cover 10% of the health care expenses and the family 30% respectively. If the person does not have an insurance and cannot afford one, the state will cover the premiums.

Health care institutions are categorized either as hospitals if the number of beds exceeds 19 or as clinics if the number of beds is less than 20. The total number of beds is appr. 1,8 million. Most of the hospitals and clinics are private (80% and 93% respectively).

The average size of hospitals is 300 beds. They provide appr. 14,5 beds/1000 population. This figure is clearly larger in Japan than in the Nordic countries. Clinics and hospitals jointly provide appr. 17 beds/1000 population. This is about the same as in the Nordic countries when



hospitals, health centres and homes for the elderly operated by health and welfare officials are combined.

Since hospitals are financed through the insurance system, costs of patient care are calculated using score points based on the complexity of the performed procedures. All hospitals have a comprehensive book keeping scheme to bill the insurer.

The average length of stay in hospitals is long, appr. 39 days. Even considering the number of the elderly population this is a high figure. Possible explanations to this are the living quarters that are small and make it difficult to be ill in these for longer periods of time. Also the Japanese tradition to care for the sick and elderly may be one contributor. Other reasons are probably the small payments charged for inpatient and outpatient visits and the reimbursement method that supports long lengths of stay in hospitals. The number of diagnostic procedures is also a contributor, since it seems to be 2-3 times larger in Japan than in the Nordic countries.

The number of personnel in hospitals is generally 20-30% less than in the Nordic countries. The numbers of physicians and nurses are at a same level. The manning of the laboratories is, however, essentially lower.

In spite of the long treatment times the total health care costs in Japan are clearly smaller than in the Nordic countries (4,98% of GNP and 6,3% of GNI in 1984).

#### **Medical engineering and the industrial environment**

Japan has a competitive industry in medical equipment. The industry works in close collaboration with the ministries (MHW and MITI) and hospitals. The industry is exporting heavily. In 1985 its production totalled 256 billion JPY of which 92 billion JPY was exported. The high value of the dollar in the recent years has backed this.

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The density of medical equipment is large in Japan. Eg. the number of CT scanners in Japan exceeds 4 000 (1 CT/30 000 population). X-ray and laboratory technicians (with a 3 year curriculum after their student examination) play a central role in the utilization of medical equipment.

The utilization of technologies is different in Japan than in the Nordic countries. Specifically endoscopy is widely used in investigations for which X-ray and laboratory tests are used in the Nordic countries. The Japanese character sets have a marked influence on the way computers are applied in health care. Keyboards are designed to facilitate communication with symbols rather than with alphabets.

The hospitals set a high reliability requirement on medical equipment. Often devices have a guarantee for 2-3 years with free service continuing up to 6-7 years depending on the importance of the hospital.

#### **Developmental trends**

The percentage of the elderly population is increasing. The present health care system cannot cope with this continuing change for long. This has already resulted in actions where the health care system is being developed on the other hand into centralised highly efficient acute care hospitals and on the other hand into small units specializing in basic care.

Another trend is the shift from diagnostics to therapy. Actions are being taken to ease the work load of nurses in wards. Developments in the technical aids for the handicapped are similarly encouraged.

The development of new devices and systems has mostly taken place within large national programmes. Funding has been provided by the Ministry of Health and Welfare (MHW) and

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The development of new devices and systems has mostly taken place within large national programmes. Funding has been provided by the Ministry of Health and Welfare (MHW) and

the Ministry of International Trade and Industry (MITI). However, now it seems that the initiative and responsibilities are shifting to the companies and private institutions.

## 1.2 Medical information systems in Japan

Appr. 80 % of the large hospitals have computers, respectively 50 % of the clinics. All university hospitals (appr. 40) have a computing centre. The most important application area is financial management. 43 % of the capacity (in 1984) was used for claiming (invoicing) the cost from the insurance funds. The next areas were the administration of patient records (28%), drug prescription and stock control (14 %), clinical laboratories (7 %) and diet instructions (5 %).

The Office for Medical Technology Development of MHW is responsible for the management of public development projects for medical information systems.

The medical information systems (MIS) comprise the following main categories: regional, hospital and clinic MIS.

Home health care is one of the main development areas. One technological solution that is being developed is called the vital sensor system (VSS). The objective of the system is to monitor hypertensive and/or ischaemic patients at home. VSS provides a short distance telemetric connection to a base receiver which communicates with the central analysis system via telephone lines. Presently the system is being tested at Suwa Central Hospital. Parameters that can be measured include ECG, body temperature, breathing rate, blood pressure and posture.

In Japan there are 30 computerized centers for the automatic analysis automatic of ECG's and appr. 1 500 hospitals and clinics are connected to these centers.

The most important problem in the development of medical information systems in Japan is that the manufacturers do not have a common line of approach. An important user problem in computerized information systems is that

physicians cannot use the keyboards correctly. This problem is now diminishing. The funding of R&D from the government in the MIS area is decreasing. Instead companies are increasingly responsible for this sector. Today the privacy of the patient records is not a problem. However, a new law protecting the rights of patients is under preparation.

A good overview of the hospital information system (HIS) situation in Japan is provided in KLun's publication<sup>1</sup>. It underlines the lack of coordination the result of which are several different HIS architectures. Examples of that are e.g. the Tokyo University Hospital System, TETUMON (see 3.6) and NTT's Shared HIS, DEIMS (see 3.7).

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<sup>1</sup> K.C. Lun. et al: Hospital Information Systems in Japan. Meth. Inform Med, 25(1986), p. 4-14.



## 2 MEDICAL INFORMATION SYSTEMS DEVELOPMENT CENTER (MEDIS-DC)

The Center is supported both by the Ministry of Health and Welfare (MHW) and the Ministry of International Trade and Industry (MITI). It was founded in 1974. The center can be viewed as an effort of the Japanese Government to support the research and development of medical information systems. However, the development of hospital information systems (HIS) in Japan is uncoordinated. Everyone is free to develop his own solution.

The Center presently employs 6 persons, mainly responsible of the administration of its projects. The Center selects a suitable organization to contract with to carry out a specific project. The projects funded are relatively large. In addition to projects the center runs advisory committees on selected areas. During the recent years the amount of funding from the government has declined. Currently it is appr. 200 MJPY. The private sector is responsible of the majority of the research and development of the information systems in health care.

In the following some key areas of activities are reviewed.

### **Regional systems and telecommunication**

Regional Emergency Care System was an example of the successful projects financed through MEDIS-DC. It is now used in 27 cities in Japan. The computer in the emergency center gets information of the vacant beds in the area. According to this information emergency care vehicles can drive to the hospital, which has the best possibilities of receiving the patient.

MEDIS-DC has also supported projects aiming to utilize modern telecommunication techniques e.g. in medical consultations in remote areas or home care of elderly patients and teletransmission of various biosignals (see the vital sensor system, p.11). Even transmission of the

endoscopic images was considered as one potential application.

#### **Hospital information systems**

MEDIS-DC has supported the development of both administrative and medical applications. The project to develop a Shared Hospital Information System (SHIS) was initiated in 1977. Its aim was to arrange centralized service for the hospitals to assist in the data processing needed for various administrative purposes. E.g. the Medical Care Insurance System requires each hospital or clinic to submit once a month insurance claims of all the activities for which they are entitled for reimbursement. This entails a huge amount of paperwork in the country.

The system also compiles various kinds of administrative statistics for the hospitals. These tasks are carried out in batch mode but the system supports also patient registration in on-line mode.

The system is currently used in about 65 hospitals. About 30 hospitals use the system also to store some medical information e.g. diagnostic statements.

#### **Medical records management system**

There is an active project to develop (funded by MITI) a computer system for the management of medical records. However, our delegation did not receive any further information of this project. The system which has several applications of computer graphics is scheduled to be tested in 1988. Part of the project is contracted to industry.

#### **Expert systems (funded by MITI)**

MEDIS-DC is also managing an umbrella project in the application of expert systems (ES) technology in medicine. The centre has minicomputer installation with a powerful backend Prolog-processor (Facom- $\alpha$ ). This system is accessible through modems and telephone lines to selected

professionals (appr. 150 physicians presently). The ES tools available at present are relatively crude; CommonLisp, Prolog and some shells (ESHECC, MECS-AI, COMEX and SHELP). The budget of this project is relatively modest 50 MJPY/yr. It started in 1984 and lasts five years. Its defined goal is to produce a software tool for building medical ES's.

The basic systems design has been completed. It is currently being coded using the Prolog-language. The tool-kit is called "Total Advanced Medical Intelligent Knowledge Engineering" (TAMEIKE).

In the perspective with ICOT's 5th Generation Computer System programme, it is evident that its intention is to stimulate physicians into experimentations with this new technology in order that when ICOT's computer nears completion also the medical field will be able to take advantage of its capabilities.

◇ PACS (funded by MITI)  
MEDIS-DC and the National Institute of Radiological Sciences (NIRS) are in collaboration carrying out a project on a medical image archiving system<sup>2</sup>. The project started in 1984 and lasts five years.

The system has the following functions:

- registration of patient data,
- input and storage of medical images,
- reading of medical images,
- retrieval and display of medical images,
- reports of statistics,
- image processing and
- maintenance support.

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<sup>2</sup> K. Ide et al.: Development of Medical Image Communication and Management System, Medical Image Technology, vol.4, No.2, 1986.

This activity runs parallel to respective development projects within the industry (e.g. NEC and Fuji).

#### **Conclusions**

Development of HIS in Japan is handled by MEDIS-DC, hospitals and industry. The roles of MHW and MITI in coordinating the efforts are seemingly not central. However, when one looks at present HIS realizations it is evident that all parties are cooperating effectively. This observation of efficient cooperation was made during the visit in several other projects as well (e.g. PACS, hyperthermia and robotics in rehabilitation engineering).

**Contact persons:** dr. Masamitsu Oshima, Dr. Koji Okamoto, mr. Sikeaki Yomoda and dr. Kazuo Ide.

**Reported by:** Jokinen, Lappi, Saranummi and Thoren

### 3 HOSPITALS

#### 3.1 Toshiba Hospital

The hospital is owned by Toshiba Corporation and provides health care services to all Toshiba employees and their families. The hospital has 310 beds and about 600 outpatients a day. It was built in 1964 and is equipped with the most modern equipment available today. The hospital has departments for internal medicine, surgery, neurosurgery, obstetrics, gynecology, pediatrics, ophthalmology, otorhinolaryngology, dentistry, neurology, orthopedics, dermatology, urology and radiology. Milestones in the history of the instrumentation of the hospital are given in Table 1.

Table 1. Introduction of some new technologies in Toshiba Hospital.

---

Year	Technology
1970	Automated Multiphasic Health Screening System (35 patients/day).
1978	Digital Subtraction Angiography (DSA)
1982	Resistive Magnetic Resonance Imager (MRI) (replaced in 1984)
1984	Superconductive MRI (1,5 Tesla, 14 s scantime/slice, ECG gating)
1985	Computed Radiography (CR) imaging system

---

In the following a summary of points of interest based on a tour in Toshiba Hospital is given:

#### **Multimodality health screening system**

This department is used in health screening of the nonsymptomatic population. The 18-step process includes

blood and other samples, check-ups of hearing, vision etc. Even chest and stomach X-ray examinations are done. All these examinations are done in one day. In this particular unit the technology used was not very modern.

#### **MRI**

Toshiba Hospital has an older resistive 0,15 T Toshiba MRI unit and a more modern 1 T superconductive MRI unit. The latter was just installed. Image quality of the superconductive unit was good. The pulse sequences were up to date including a short echo time. Physicians using the equipment consider the superconductive unit better. However, it was obvious that the surface coil development was not yet finished. In the 0,15T unit body images were always created with a special coil. Image quality appeared to be acceptable.

#### **Cancer treatment**

Cancer treatment is carried out with conventional radiotherapy equipment and also using a capacitive 8 MHz hyperthermia machine. The tissue is heated by a high frequency generator capable of a HF power about 1,5 kW<sup>3</sup>. The method is said to be very effective on thin persons.

#### **○ PACS**

A PACS system was included in the imaging system. It consists of a laser-scanner with 0,1 mm/pixel and 10 bit resolution, two optical laser discs each with 3,6 Gbyte connected to a Vax 11/750. The system should soon be connected to Fuji's computed radiology system. 3-D image reconstruction was available as a research tool.

**Reported by:** Lofstedt, Kormanö and Saranummi

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<sup>3</sup> Mitsuyuki, et al.: Multi-Institutional Studies in Hyperthermia.... Cancer. vol. 58, No. 8, 1986, p. 1589-95.

### 3.5 Department of Radiology, Kyoto University Hospital

The clinic has two whole body PET systems and a cyclotron for isotope production. The systems are used for metabolic studies and are in clinical routine use.

The clinic also has one MRI system from General Electric. This unit work with a magnetic field strength of 1,5 Tesla. It is superconductive and is totally used for clinical tasks. Spectroscopy applications are of little importance. The installation is capable of handling 4 patients a day. No research is done with this machine.

○ A PACS-system is being developed at the department. It consists of a worki station made by Hitachi. The resolution of this is not comparable to the Swedish made IMTEC-station. Data is transmitted in this PACS-system along an optical fibre network. Images are stored on optical discs. The data compression ratio when storing images is 20x.

Contact person: Prof. Mitsuyuki Abe

Reported by: Thorèn

### 3.6 Computing Centre, Tokyo University Hospital

The University of Tokyo, one of the most appreciated universities of Japan, was founded in 1877. The total number of students in May 1986 was 19 581. Of these 5 365 were postgraduate students. The total number of personnel was 8 102 of which 1 644 were professors or associate professors.

The hospital information system of the University Hospital of the University of Tokyo was presented by the director of the Computing Center, professor Shigekoto Kaihara. Professor Kaihara, who also is the president of IMIA (International Medical Informatics Association), gave an overview of data processing in health care<sup>6</sup>,<sup>7</sup>,<sup>8</sup> as well as of the status of medical informatics in Japan.

There are only 10 full time employees in the computing centre. Planning, training, research and development are their duties, but they don't have to take care of the daily routines or maintenance of the computer systems.

Six universities in Japan have a department of medical informatics. The professor in medical informatics is acting simultaneously as the director of the computing centre of the university hospital.

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<sup>6</sup> JAPAN 1986. An international comparison, Keizai Koho Center. 98 pages.

<sup>7</sup> Health and Welfare Services in Japan 1986. Ministry of Health and Welfare. 74 pages.

<sup>8</sup> K.C. Lun, et al.: Hospital Information Systems in Japan. Meth. Inform. Med. 25(1986), p. 4-14.



physician needs facts presented in a purposeful way rather than inferences. Appr. 90% of the work has to do with facts, only 10% involve inferences. However, intelligent frontends (based on Prolog or Lisp) to databases of medical knowledge have to be developed.

As one of the necessary steps to be taken, a bridge between the patient database and a Prolog environment was under development. The Computing Center had completed earlier a bridge between the patient database and SAS-files.

◊ The wide use of PACS for transfer and processing of medical images was considered at present rather to be inhibited by economical than technical reasons. The department of radiology will by the end of the year get a new building. A small scale local area network will be built there to test the concepts of PACS. Eventually there will be three different networks: one for digital data, one for images and one for videsignals.

Contact person: Prof. Shigekoto Kaihara

Reported by: Jokinen and Saranummi

Doppler without aliasing, high sensitivity and low cost will be possible. Tissue characterization in ultrasound will be based on sound velocity, frequency dependent attenuation, backscatter, nonlinear attenuation and flow measurement. Transducer technology for this will be come available.

An endoscope with a high resolution CCD camera (100 000 pixels, in future 1000 x 1000 pixels) was already in production.

### PACS

Image volumes produced in a 500 bed hospital require a storage capacity of appr. 7,6 GB/day without compression. Half of this comes from imaging. Toshiba's approach "Structured PACS" covers a LAN working at > 100 MB/s, data compression, data base management system, storage capacity of > 2 TB and workstations for diagnostic and reviewing purposes. Toshiba aims at having the possibility of interfacing different brands of imaging equipment to their PACS. In 3-D image reconstruction the aim is to support the diagnostic process (3-D images are easier to understand than the conventional CT-slices). 3-D can be most effectively utilized in the planning of neuro- and plastic surgeries. In medical education it will also find uses.

### Conclusions

The presentations were well prepared and informative. Nothing revolutionary or totally new came up. Toshiba's 3-D imaging and PACS developments are interesting and should be kept in mind while planning Scandinavian hospital information systems. The visit to Toshiba ended with a reception at the Headquarters.

Contact persons: Dr Katsuoshi Saito, mr. Yuichi Imasato, mr. Masamichi Katsurada, mr. Takehiko Goro, dr. Kazuhiro Iinuma, mr. Kouchi Kita, mr. Nobuo Kumano, and mr. Sadayasu Shibata.

Reported by:Korman and Saranummi

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Reported by:Kormano and Saranummi

a central computer within the hospital supported by a high speed fiberoptic LAN (100 Mbit/s) onto which lower speed (10 Mbit/s) segments will be hooked.

Planned hospital functions within this system include finance and accounting, general administration, statistics, billing and receipt. Clinical functions include record keeping, drug information, prescriptions, examinations and test ordering. Interfaces between real time systems i.e. intensive care systems are developed. Image handling and processing will be integrated in the system. Special efforts are made to develop doctor-data interfaces. One system being developed helps the doctor to write diagnoses and interpretations of X-ray pictures (today limited to stomach examinations). For larger hospitals PACS-functions are expected to load the system too much and a separate LAN including just the 100 Mbit/s ring is being developed for this case. Again the main computer power is concentrated in a central mainframe and special workstations are being developed to handle images (including compression and decompression) for viewing and analysis. No indication was given when these systems were expected to be announced. Nor was information about standards or general openness of the systems given.

#### **Linear accelerator and treatment planning**

A special feature of the linear accelerator is a controllable multileaf collimator system. This collimator system is simulated in the THERAC 2300. Thus "optimization" of the treatment pattern could be done including active uses of the variable collimator. The THERAC 2300 uses CT generated images of the patient to calculate simulated dose distributions from a given source. A display shows the CT-picture overlapped with the simulated dose distribution. With a knob the beam-source can be manipulated and the dose distribution is updated in real time. No objective or automatic optimization is implemented, only "visual optimization" is done. The high speed calculator unit for

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### Computer center

The most impressive part of the tour was probably the visit to the NEC computer center. In a hall as large as an exhibition hall, with no signs of extra security, hundreds of mainframes were scattered among countless rows of disk units, printers, paperstacks and workstations. In short more like a chaotic warehouse than a computer center. In the center of all this a SX-2 supercomputer was placed on a small cleared area. The SX-2 is a 1,3 Gflops super-computer, probably the fastest single processor computer in the world today. The load was 100 % continuously during our visit. A very large fraction of the usage is simulation of VLSI circuits (note, however, at least two companies in Japan have bought CRAY-XMP recently, officially because software support for the CRAY is better, but the large trade unbalance with USA may be the true reason.) Within a year a new 15 Gflops NEC computer will be installed.

Contact persons: Mr. Chudo Kazusa, dr. Kiyonari Inamura, mr. Kyosuke Ishii and mr. Shinishiro Shimizu.

Reported by: Olsson

## 7.2 PACS

Hitachi, NEC and Toshiba are all developing PAC systems. Industry is cooperating through JAPACS (Japanese Association for PACS). Most of the members of JAPACS are from industry, only a few come from research. The objective of the cooperation is to agree on a communication protocol for image transfer and archiving. The ACR-NEMA image standard is considered too complicated and the Japanese are preparing their own standard "MIPS" (medical image processing standard) of which the 1st draft was published in 1986. JAPACS meets annually to present and discuss progress in the PACS area.

The reasons for the great investments in PACS research in Japan are for the moment at least mainly domestic. A large member of the larger hospitals will need new buildings in the near future. This provides a good opportunity to sell PAC systems (and LAN's). The Japanese local area network is not based on Ethernet nor on any other western communication protocol. This will be one thing that may make it difficult to export the Japanese PACS principles commercially.

In Japan the arguments in favour of PACS are

- Increased quality of medical care, through speed of retrieval, complete archives, protection against loss of films, interpretation of images with associated patient data and image processing facilities to support diagnosis,
- Improved economy, through decreased needs of manpower and of image archive space and improved overall efficiency through a larger output per unit time,
- Improved patient care, through shortening of hospital stay, decreased radiation dose and waiting time.

Table 4 summarizes some facts of the development projects of the three companies.

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Table 4. A summary of the PACS development projects of Hitachi, NEC and Toshiba

Characteristic	Hitachi	NEC	Toshiba
Evaluation hospital	Kyoto university Hospital, Kobe university	Hokkaido University	Toshiba Hospital
Image workstation			
- resolution (pixels)	1000x1000	1000x 1000	1000x1500
- displays	3	2	2+console
Data compression	?	20x(retrieval 1s)	?
Optical disc/Jukebox	32 discs	?	?
LAN	?	local (10Mbs) large (100 Mbs <sup>1</sup> )	?
Film digitizing	yes (no details)	yes (2000x2000, 26s, 5 linepairs/mm, CCD)	?

1) available after 2 years (1989)

**Conclusions**

PACS is still in a development stage in Japan. The industry is rather interested to get into contact with European research and industry in PACS. This is probably due to the fact that they are moving away from ACR-NEMA and hope to

gain support for their concept. Additional and more detailed information on Japanese PACS will be available after the Dutch delegation has made their 2 week tour in Japan in May 1987.

Reported by: Saranummi

Japan's research in this area emphasizes the application of mechanical in technical fields. This is further supported by the work taking the ongoing projects in this area in Japan. The Japanese Government (Ministry of Education, Science and Culture) has been actively promoting the development of this field. The Japanese Government has been actively promoting the development of this field. The Japanese Government has been actively promoting the development of this field.

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## 8 NORDIC-JAPAN WORKSHOP

### 8.1 Objectives and methods of work

The purpose of the workshop was to review briefly the research situation in the Nordic countries and Japan, to compare and discuss the problems, similarities and differences, and to explore areas of common interest and possible ways of cooperation.

The objectives of the workshop were

- to list items which both the Japanese and Nordic sides consider mutually interesting and,
- to consider what is the appropriate way of starting and organizing cooperation e.g. by using the following alternatives
  - exchange of information,
  - meetings between specialists,
  - organizing of workshops,
  - exchange of scientists, and
  - planning of collaborative projects.

For detailed discussions the workshop was divided into 5 subgroups (Appendix 4): radiology and cancer therapy, medical imaging and PACS, biosensors, new technologies in biomedical engineering, and mechatronics in medicine.

The participants and chairmen of each subgroup are listed in Appendix 5.

## 8.2 Workshop results

The results were reviewed in a concluding discussion. The results obtained in each subgroup are listed below.

### **Radiology and cancer therapy**

The following common interests were identified:

- hyperthermia treatment,
- quality control & quality assurance,
- computer aided radiotherapy (CART),
- positron emission tomography (PET),
- magnetic resonance imaging (MRI) low field,
- screening,
- laser therapy,
- proton therapy,
- immunoradioisotopes, and
- stable isotopes,

### **Medical imaging and PACS**

The subgroup discussed the interaction between industry and users in PACS development. The discussion concluded with the following items of mutual interest:

- design requirements of PACS,
- clinical and economical justifications of PACS, and
- standards and communication network.

### **Biosensors**

The following interests were identified

- immobilization technologies (operational stability and sensitivity of biomolecules, chemical modification methods),
- biocompatibility (in-vivo type biosensor),
- optical detection methods (integrated optics, advanced optoelectronics).

ENCLOSURE 4

VISIT TO NEC FUCHU WORKS

WEDNESDAY, March 11

- 08.00 Leave the hotel by bus
- 09.00 Introduction to NEC's hospital automation system
- 09.40 Comment by Nordic delegation (Saranummi or Thoren)
- 10.00 Demonstrations
  - o Local PACS System
  - o Teleradiology System
  - o Radiotherapy Planning System
- 12.00 Lunch
- 13.00 Departure

**PROGRAM FOR THE WORKSHOP**

**FUTURE COOPERATION BETWEEN JAPAN AND THE NORDIC  
COUNTRIES IN MEDICAL TECHNOLOGY**

**Date:** Saturday, March 14, 1987  
**Time:** 09:00  
**Place:** Sweden Center Building, 2 Floor  
**Chairmen:** Professor M. Saito  
Professor N. Saranummi

**PROGRAM**

- 09:00 - 09:10 Introduction, purpose of the workshop  
(Enclosures 1 and 2)
- 09:15 - 10:45 Work in subgroups
- 10:45 - 11:00 Coffee
- 11:15 - 11:50 Concluding discussion and future activities
- 11:15 Chairmen's reports
- 11:50 Closing the workshop
1. Thankings to the Japanese hosts by  
Professor Niilo Saranummi (Finland)  
M.Sc. Ulf Thoren (Sweden) and  
Prof. Sverre Grimnes (Norway)
  2. Invitations to the Nordic countries  
by M.D. Risto Lappi
  3. Closing remarks by Dr. Koji Okamoto  
and Professor Masao Saito
  4. Closing by Mr. Stefan Flodberg
- 12:30 - Lunch at the Restaurant Stockholm

GROUP 2. MEDICAL IMAGING AND PACS

**Japanese Participants**

**Dr. Kiyonari Inamura (Chairman)**  
Associate Chief Engineer  
Hospital Information Systems Div.  
NEC CORPORATION

**Mr. Yuichi Imasato**  
Assistant to General Manager  
Medical Systems Division  
TOSHIBA CORPORATION

**Nordic Participants**

**Prof. Niilo Saranummi (Chairman)**  
Laboratory Director, Medical Engineering Laboratory  
Technical Research Center of Finland, Tampere

**M.Sc. Ulf Thoren**  
Head of the Medical Technology Department  
KAROLINSKA HOSPITAL, STOCKHOLM